

ADAPTATION
Pre-AP Seventh Grade Science
2011-2012

Description

Organisms may be classified based on their unique characteristics. Many of these characteristics are the result of adaptations that occur in order to ensure survival. Adaptations may be divided into three categories, structural, physiological, and behavioral. Organisms depend on their physical features to help them obtain food, keep safe, build homes, withstand weather, attract mates, and reproduce. These physical features are called structural adaptations. Structural adaptation happens over a long period of time in the form of changing genetic traits when the better suited forms of an organism reproduce more successfully in a process called natural selection. The shape of a bird's beak, the number of fingers, the size of a plant's leaves, or the thickness or thinness of a plant's stem, are all structural adaptations that occur as a result of natural selection. In some cases, the inability of organisms to adapt quickly enough have led to their extinction or endangerment. Behavioral adaptations involve the different ways in which an animal reacts to its environment. Nocturnal animals which are active at night, arboreal animals which make their homes in trees, and fossorial, or burrowing animals, are all examples of behavioral adaptations. Opening and closing of stomata in plants due to availability of water are also behavioral adaptations. Physiological adaptations permit an organism to perform special functions like regulating temperature or phototropism and other homeostatic functions. Unlike natural selection that requires generations to occur, physiological adaptation is generally narrow in scope and involves response of an organism to a specific stimulus like tanning of skin when exposed to the sun. The fossil record can trace the changes and adaptations that organisms have made throughout Earth's history. Emphasis is placed on the effects of individual variation on survival within one species in a changing environment.

Connections

Adaptation enables organisms to survive in their environment. Natural selection is a process by which organisms with genetic traits more well-suited for an environment reproduce, while those with traits not well suited may become extinct or endangered. Passing of genetic material from parent to offspring is examined in detail in a previous unit on genetics. The environment also plays a large role in adaptive processes. Interactions of organisms within an ecosystem determine which species will be successful and which will not; these interactions are studied in an upcoming unit on ecology.

Enduring Understandings

1. Traits essential for survival may be inherited through genetic material or acquired as a result of environmental factors.
2. Organisms can be classified based on these traits using a dichotomous key.
3. Charles Darwin first proposed the theory of natural selection based on his observations of nature.
4. Natural selection is a process by which organisms with traits most well-suited for survival live to reproduce and therefore pass on beneficial traits to their offspring. Organisms with traits detrimental to survival do not survive to reproduce, thereby reducing gene frequency for non-beneficial traits.
5. Analogous traits correspond in function, but are not evolved from corresponding organs (e.g., the wing of a bee and the wing of a hummingbird).
6. Homologous traits are evolved from the same organs, but over time, the function has changed (e.g., the wing of a bird and the foreleg of a horse are homologous).
7. Structural adaptations are physical characteristics that help ensure an animal's survival, and occur as a result of natural selection over many generations.

8. Behavioral adaptations include an organism's responses to its environment, and may be genetically inherited or acquired as a result of environmental factors.
9. Physiological adaptations generally occur within short time frames as an organism responds to specific environmental factors in an effort to maintain homeostasis.
10. Earth's fossil record can be traced back to one-celled organisms that existed during Precambrian Time more than 500 million years ago, moving forward to modern plants and animals in the current era.
11. Relationships between organisms over time may be graphically represented with a phylogenetic tree.
12. The adaptive history of life on Earth can be tied to specific eras and periods of geologic time.
13. Changes in the physical conditions of an ecosystem (abiotic factors) affect the survival of organisms and can result in adaptive changes.

Essential Questions

1. How are animals classified?
2. Who was Charles Darwin and what were his contributions to the theory of natural selection?
3. What is natural selection and how is it related to adaptation and survival?
4. What are some examples of adaptive traits found in modern plants and animals?
5. What is the difference between structural, behavioral, and physiological adaptations?
6. What geological evidence is there that modern organisms are related to organisms found in the fossil record?
7. How can traits be compared?
8. How can changing the physical environment affect the survival of organisms?
9. How can changes in the physical environment affect adaptive processes of organisms?

Essential Concepts and Skills

By the end of the unit the student is expected to:

1. compare and contrast inherited and acquired traits
2. classify animals using a dichotomous key
3. describe the theory of natural selection and its relationship to gene frequency
4. explain that adaptations occur as responses to stimuli in the environment
5. identify Charles Darwin and give examples on which he based his theory of natural selection
6. compare and contrast analogous and homologous structures
7. create a phylogenetic tree showing the relationships of organisms over time
8. design an animal with structural adaptations that will enhance its chance for survival
9. compose a story describing the behavioral adaptations an organism exhibits in response to stimuli in its environment
10. deduce which physiological adaptations might occur based on given environmental conditions
11. justify why specific physiological adaptations help maintain homeostasis
12. analyze environments to determine which adaptations would be most beneficial
13. create a timeline showing the history of life on Earth and how it relates to specific eras and periods of geologic time
14. predict whether or not an organism will survive abiotic changes in its environment

What do students typically have as misconceptions?

1. Students believe that transmitted characteristics are acquired during the life time of the animal.
2. Acquired characteristics can be inherited.
3. Adaptation is something an organism chooses.
4. Evolution is goal-directed.
5. Evolutionary changes are driven by need.

Preconception Survey

1. What special physical adaptations do birds have?
2. What behavior adaptations do birds have?
3. Why are they important?
4. How did these adaptations occur?

Formative Assessment Items

1. Conduct a simulation where students can model the process of changing gene frequency.
2. Dissect a chicken wing in order to observe its structure and describe its function.
3. Given environmental scenarios reflecting abiotic changes, have students debate over whether or not those changes would affect survival of specific organisms within that environment
4. Use the Socratic method to hold a classroom discussion about natural selection, its origins and implications

TEKS Covered

7.11 Organisms and environments. The student knows that populations and species demonstrate variation and inherit many of their unique traits through gradual processes over many generations. The student is expected to:

- A) examine organisms or their structures such as insects or leaves and use dichotomous keys for identification.
- B) explain variation within a population or species by comparing external features, behaviors, or physiology of organisms that enhance their survival such as migration, hibernation, or storage of food in a bulb.
- C) identify some changes in genetic traits that have occurred over several generations through natural selection and selective breeding such as the Galapagos Medium Ground Finch (*Geospiza fortis*) or domestic animals. **Supporting Standard-Category 4**

7.12 Organisms and environments. The student knows that living systems at all levels of organization demonstrate the complementary nature of structure and function. The student is expected to:

- A) investigate and explain how internal structures of organisms have adaptations that allow specific functions such as gills in fish, hollow bones in birds, or xylem in plants.

College Board Standards Covered

LSM-PE.1.1.1 Construct a **representation** that reflects the appropriate time scale of Earth's history and includes the variation of organisms over time. Representation describes major evolutionary developments (e.g., the first organism, oxygen in the atmosphere, the first land plants, appearance of vertebrates, etc.).

LSM-PE.1.1.2 Construct a representation, using information from the fossil record, that describes the organisms present during several different time periods in Earth's history.

LSM-PE.1.1.3 Observe the anatomical structures of a variety of organisms, and describe the similarities and differences among them. Organize the organisms into groups based on their similarities and differences. Make a **claim** about how recently organisms among the groups

shared a common ancestor, and justify that claim based on the degree of similarity of their characteristics.

LSM-PE.1.1.4 Construct a simple model (e.g., phylogenetic tree), based on anatomical similarities and differences, of the degree of relatedness of different species. If necessary, revise the model based on new or additional anatomical evidence.

LSM-PE.1.2.2 Give examples, using information gathered from print and electronic resources, of natural environmental changes that have occurred in the recent past. Collect and organize data about the number, kind and/or geographical distribution of organisms before and after these changes occurred. Make a claim about how these environmental changes have affected the number, kind and/or distribution of specific organisms living in these environments. Using these examples of environmental changes and the data on number, kind and/or geographical distribution of organisms, make and justify a claim about the effects of changes in environmental conditions on the survival of some organisms compared to the effects of these changes on the survival of other organisms.

[BOUNDARY: The focus is on the effects of changes in the environment on the survival of organisms. The examples should not only describe the effects on the survival rates of various species but also describe the effects of individual variation on survival within one species.]

LSM-PE.1.2.3 Give examples, using information gathered from print and electronic resources, of environmental changes that have occurred in the recent past as a result of human actions. Collect and organize data about the number, kind and/or geographical distribution of organisms before and after these changes occurred. Make a claim about how these environmental changes have affected the number, kind and/or distribution of specific organisms living in these environments. Using these examples of environmental changes and the data on number, kind and/or geographical distribution of organisms, make and justify a claim about the effects of changes in environmental conditions on the survival of some organisms compared to the effects of these changes on the survival of other organisms.

LSM-PE.1.2.4 Give examples, using information gathered from print and electronic resources, of observations made by Charles Darwin of variation within species and of changes in environmental conditions that he used in the development of his **theory** of natural selection. For each example, describe the relationship between the variation within species and the changes in the environmental conditions.

LSM-PE.3.1.3 Give examples of physical (abiotic) conditions that affect the survival of specific kinds or groups of organisms (e.g., fish that live in salt water versus those that live in fresh water; algae that can survive only within a certain range of light; fungi and plants that require a certain amount of water to survive). Use these examples to make and justify a claim about the effect of physical (abiotic) conditions on a specific organism's survival.

LSM-PE.3.1.4 Use data as evidence to make and justify a claim concerning whether or not a population of organisms is affected by varying environmental conditions in an ecosystem. Data show information regarding the number of organisms of each species in an ecosystem under varying environmental conditions (e.g., what happens to the number of a particular species — including organisms that can survive significant changes and those that cannot — when temperature, soil, moisture or sunlight varies over time). Using these data, predict the survival of a particular species in a specific ecosystem when certain changes occur to the physical (abiotic) environment.

LSM-PE.3.1.5 Make a general claim about the relationship between organisms' traits and their chances of survival. Justification for the claim is based on data from several populations of organisms with varying traits and under a variety of environmental conditions.

[BOUNDARY: The traits presented in the data table should be appropriate for students in grades 6–8 in that the students are able to identify the connection between each trait and the environmental factors.]

Vocabulary

natural selection, gene frequency, structural adaptations, behavioral adaptations, physiological adaptations, extinction, endangerment, dichotomous key, inherited traits, acquired traits, biotic factors, abiotic factors, stimuli, homeostasis, evolution, population, species, migration, hibernation, camouflage, mimicry, niche, selective breeding, ancestor, analogous traits, homologous traits, fossil record, phylogenetic tree